Asian Journal of Surgery (2013) **36**, 36—39

Available online at www.sciencedirect.com

SciVerse ScienceDirect

journal homepage: www.e-asianjournalsurgery.com

ORIGINAL ARTICLE

Bariatric surgery in Singapore from 2005 to 2009

Rajat Goel [a,*], Amit Agarwal [a], Asim Shabbir [a], Jimmy B.Y. So [a], Shanker Pasupathy [b], Andrew Wong [c], Anton Cheng [d], Davide Lomanto [a]

[a] *National University Hospital, Singapore*
[b] *Singapore General Hospital, Singapore*
[c] *Changi General Hospital, Singapore*
[d] *Khoo Teck Puat Hospital, Singapore*

Received 24 April 2012; received in revised form 11 June 2012; accepted 9 August 2012
Available online 4 October 2012

KEYWORDS
bariatric surgery;
gastric banding;
morbid obesity;
Singapore;
survey

Summary *Introduction:* Obesity is a major public health concern worldwide, including Singapore. Bariatric surgery has grown in popularity to combat this situation, and innovations in this field have led to the emergence of new bariatric procedures. For the healthy growth of this specialized field of surgery, it is mandatory to audit the progress and state of bariatric surgery at regular intervals.
Methods: An e-mail questionnaire survey was conducted in all the leading hospitals of Singapore practicing bariatric surgery between 2005 and 2009. All four hospitals to which the questionnaire survey was mailed responded. The responses from these hospitals were tabulated and analyzed.
Results: Between 2005 and 2009, a total of 278 bariatric procedures were performed on 151 men and 127 women with a mean age of 40.34 years (range: 18—64 years) by 12 practicing surgeons. The mean body mass index was 42.25 kg/m^2 (range: 31.4—73 kg/m^2). All the operations were performed laparoscopically. The most commonly performed procedure was adjustable gastric banding (81.65%), followed by sleeve gastrectomy (13.66%) and Roux en Y gastric bypass (3.95%).
Conclusion: There is a flux of newer procedures in Singapore. Adjustable gastric banding, which was the only available procedure being performed in 2004, was gradually being replaced by other procedures such as sleeve gastrectomy and Roux-en-Y gastric bypass in 2009.

* Corresponding author. Minimally Invasive Surgical Centre, Department of Surgery, Yong Loo Lin School of Medicine, National University of Singapore, 5 Lower Kent Ridge Road, 119074 Singapore.
E-mail address: goelrajat27@gmail.com (R. Goel).

http://dx.doi.org/10.1016/j.asjsur.2012.08.006

1. Introduction

The epidemic of obesity has escalated globally over the past few years.[1] The World Health Organization figures indicate that globally in 2008 approximately 1.5 billion adults (aged > 20 years) were overweight [body mass index (BMI) > 25 kg/m^2], and of these, >200 million men and nearly 300 million women were obese (BMI > 30 kg/m^2).[2] Data from The Ministry of Health, Singapore indicate that from 1992 to 2004 the prevalence of obesity (BMI > 27.5 kg/m^2) in adults (18–69 years) had increased from 5.1% to 6.9%.[3] Obesity has become one of the greatest public health concerns. Overweight and obesity are independent risk factors for diabetes, cancer, cardiovascular disease, and premature death.[4] For obese individuals, bariatric surgery has emerged as a viable and sustainable management alternative. The advent of laparoscopy for bariatric surgery has made it more acceptable and desirable. It is very important to audit the state of bariatric surgery[5] by answering certain basic questions regarding the number and details of such procedures being performed.

Here we present an audit of bariatric surgery in Singapore for the past 5 years.

2. Methods

2.1. Questionnaire

An e-mail survey, consisting of four questions Table 1, was sent to all practicing bariatric surgeons in four hospitals in Singapore: National University Hospital, Singapore General Hospital, Changi General Hospital, and Khoo Teck Puat Hospital.

2.2. Data analysis

A tabular presentation of the data received was prepared and certain derived data were calculated. The data were analyzed using Microsoft Excel 2007.

3. Results

3.1. Response rate

All the four hospitals to which the questionnaire was sent responded. A total of 278 bariatric procedures were performed in Singapore by 12 bariatric surgeons between 2005 and 2009. No open bariatric surgery was performed at any of the hospitals during this period. There were 151 male and 127 female patients with a mean age at surgery of 40.34 years (range: 18–64 years) and mean BMI of 42.25 kg/m^2 (range: 31.4–73 kg/m^2).

Table 2 shows the distribution of procedures from 2005 to 2009. The most commonly performed procedure was laparoscopic adjustable gastric banding (LAGB; 81.65%), followed by laparoscopic sleeve gastrectomy (LSG; 13.66%), laparoscopic Roux-en-Y gastric bypass (LRYGB; 3.95%), and others (0.7%). Comparing the procedural trends from 2005 to 2009 with those in 2004, it can be seen in Table 3 that more complex procedures like LSG and LRYGB have been accepted and are gaining popularity among patients and surgeons. LAGB is now falling out of favor and has seen a declining trend from 100% of 112 procedures in 2004 to 31.4% (n = 17) of total procedures in 2009.

Table 4 shows the complications for 5 years. Among 227 LAGB procedures, 30 patients (13.2%) developed complications, with three patients (1.3%) developing early

Table 1 Questionnaire.

S,NO.	TYPE OF PROCEDURE	TOTAL No. 2005–2009	PERCENTAGE
1	LAPAROSCOPIC SLEEVE GASTRECTOMY		
2	OPEN SLEEVE GASTRECTOMY		
3	LAPAROSCOPIC ADJUSTABLE GASTRIC BANDING		
4	OPEN ADJUSTABLE GASTRIC BANDING		
5	LAPAROSCOPIC ROUX-en-Y GASTRIC BYPASS		
6	OPEN ROUX-en-Y GASTRIC BYPASS		
7	LAPAROSCOPIC LONG- LIMB AND VERY LONG- LIMB GASTRIC BYPASS (>100CM)		
8	OPEN LONG- LIMB AND VERY LONG- LIMB GASTRIC BYPASS (>100CM)		
9	LAPAROSCOPIC BILIOPANCREATIC DIVERSION (SCOPINARO PROCEDURE)		
10	OPEN BILIOPANCREATIC DIVERSION (SCOPINARO PROCEDURE)		
11	LAPAROSCOPIC DUODENAL SWITCH		
12	OPEN DUODENAL SWITCH		
13	LAPAROSCOPIC VERTICAL BANDED GASTROPLASTY		
14	OPEN VERTICAL BANDED GASTROPLASTY		
15	INTRAGASTRIC BALLOON		
16	ELECTRONIC PACERS/ BLOCKERS		
17	OTHERS		
18	TOTAL		100%

1. Approximate no. of Bariatric operations performed during 2005–2009 in your hospital and their demographic profile?
2. Approximately how many surgeons performed the bariatric procedure in your hospital during this period?
3. What are the relative percentages of the types of procedures performed at your hospital considering the total percentage to be 100?
4. Please also provide early and late complications encountered during this period?

Table 2 Distribution of procedures performed in 2005–2009.

Type of procedure	Total no. of procedures	Percentage
Laparoscopic adjustable gastric banding	227	81.65
Laparoscopic sleeve gastrectomy	38	13.66
Laparoscopic Roux-en-Y gastric bypass	11	03.95
Laparoscopic long limb and very long limb gastric bypass (>100 cm)	1	0.359
Laparoscopic bilio-pancreatic diversion (Scopinaro procedure)	1	0.359
Total	278	100

complications (<3 months) and 26 patients (11.4%) developing late complications, and there was one death. For 38 LSG procedures, there were five complications (13.1%), with four patients developing early complications (10.5%) and one patient (2.6%) developing late complications. For 11 LRYGB procedures, four patients (36.3%) developed early complications. There was no mortality in either the LSG or LRYGB group.

4. Discussion

The health burden of obesity, as measured by quality-adjusted life years lost has more than doubled from 1993 to 2008.[6] Obesity leads to several health problems such as cardiovascular diseases, diabetes, osteoarthritis, obstructive sleep apnea, and some cancers.[7] Bariatric surgery provides a long-term solution for this situation. Currently, the Ministry of Health, Singapore recommends that bariatric procedures should be considered for all those who have morbid obesity (BMI $\geq$ 37.5 kg/m^2) or severe obesity (BMI $\geq$ 32.5 kg/m^2) with medical comorbidity.[3] Bariatric surgery in Singapore has shown a paradigm shift in terms of type of surgery and access route for surgery, from open RYGB and vertical banded gastroplasty[8] from 1987 to 1997 to combined open and laparoscopic AGB from 1999 to 2003,[8] and complete LAGB from 2001 to 2005.[9]

We conducted a survey to investigate the trends in bariatric surgery over the past 5 years in Singapore, and documented the number and types of bariatric procedures being performed in all the four major hospitals. The data indicate that newer bariatric procedures have been introduced in Singapore. The earlier favored procedures are losing their popularity and are being replaced by newer and more complex procedures. The percentage of AGB among various bariatric procedures decreased from 100% in 2004 to 31.48% in 2009. This may be because of failure of gastric banding to produce the desired long-term weight loss and associated complications such as erosion, ulceration, and band migration. Moreover, the gastric band needs frequent adjustments that require multiple visits, incurring cost and lifelong follow-up that is not welcomed by patients.[9,10] Considering the absolute numbers, the total number of procedures being performed has decreased from 102 in 2004 to 54 in 2009. These figures match the global trends that show a plateau phase for all bariatric surgery.[11] This may be because all procedures when started are met with an initial enthusiasm and later they lose some of their early success. There was one fatality in 2006, which resulted in negative publicity and the number of procedures decreased in the next few years.

LAGB had more late complications such as band slippage, band erosion, and access-port-related problems. Twenty-six (11.4%) of 227 patients experienced complications and there was one fatality (septic complication after redo band), which also explains the decrease in the number of LAGB procedures in Singapore. In the LSG group only four (10.5%) of 38 patients developed early complications: bleeding and staple line leak in one, and gastroesophageal reflux in two. One (2.6%) patient developed late complications in terms of weight gain but there was no mortality. In the LRYGB group, two (18.1%) of 11 patients developed significant early complications: one had jejunal injury and the other acute gastric dilatation. The high percentage of complications for LRYGB is misleading because the number of procedures was small; there were no significant late complications or mortality, and there is a learning curve in LRYGB.

The introduction of complex procedures such as LSG and LRYGB in Singapore was after these procedures had already established their popularity in the United States, Europe and Asia.[12] Current trends suggest that these procedures have found their place in Singapore. The rise in the number of sleeve gastrectomies seen in Singapore parallels the global trends. The reason for this may be the ease and speed of this procedure compared to other bariatric procedures,[13] lack of foreign bodies, and good early results. Long-term follow-up data may however influence the popular appeal of this procedure.

The weakness of this survey resides in the fact that we have not been able to include the data from independent surgeons performing bariatric procedures in Singapore. However, the strength of this survey lies in the fact that this was a collective attempt to evaluate the bariatric surgery trends in Singapore.

Table 3 Comparing the procedural trends in 2005–2009 with those in 2004.

Type of procedure	2004	2005	2006	2007	2008	2009	Total (2005–2009)
Laparoscopic adjustable gastric banding	102	131	52	12	15	17	227
Laparoscopic sleeve gastrectomy	0	0	3	3	5	27	38
Laparoscopic Roux-en-Y gastric bypass	0	0	0	1	2	8	11
Laparoscopic long limb and very long limb gastric bypass (>100 cm)	0	0	0	0	0	1	1
Laparoscopic bilio-pancreatic diversion (Scopinaro procedure)	0	0	0	0	0	1	1
Total	102	131	55	16	22	54	278

Table 4 Data on complications in 2005—2009.

LAGB (n = 227)	Type	No.	Percentage
Early (<3 mo)	Aspiration pneumonia	1	
	Wound infection	2	
	Total	3	1.3
Late (>3 mo)	Slippage	6	
	Erosion	5	
	Reflux esophagitis	1	
	Port and tubing leaks	5	
	Port infection	3	
	Dilatation gastric pouch	4	
	Port displacement	2	
	Total	26	11.4
	Mortality	1	0.4
Combined total		30	13.2
LSG (n = 38)			
Early (<3 mo)	Bleeding	1	
	Staple line leak	1	
	Gastroesophageal reflux disease	2	
	Total	4	10.5
Late (>3 mo)	Weight regain	1	
	Total	1	2.6
	Mortality	0	
Combined total		3	7.8
LRYGB (n = 11)			
Early (<3 mo)	Wound infection	2	
	Acute gastric dilatation	1	
	Jejunal injury	1	
	Marginal ulcer	0	
	Total	4	36.3
	Mortality	0	
Late (>3 mo)	Anemia, dumping syndrome	0	
Combined total		4	36.3

LAGB = laparoscopic adjustable gastric banding; LRYGB = laparoscopic Roux-en-Y gastric bypass; LSG = laparoscopic sleeve gastrectomy.

In order to increase the accuracy and reliability of the data, it is important to have a registry with compliance from all surgeons in Singapore practicing bariatric surgery.

In conclusion, there has been an increase in newer procedures for bariatric surgery in Singapore, which parallels the global trend. LAGB, which was the only available procedure being performed in 2004, has gradually been replaced by other procedures such as LSG and LRYGB in 2009.

Disclosure

All authors declare that they have no competing interest and no relevant financial interest.

References

1. Popkin BM, Doak CM. The obesity epidemic is a worldwide phenomenon. *Nutr Rev*. 1998;56:106—114.
2. World Health Organization. *Obesity and Overweight*. *Fact Sheet No 311*. Available at, http://www.who.int/mediacentre/factsheets/fs311/en/index.html; 2012. Accessed 16.04.11.
3. Ministry of Health. *National Health Survey 2004, Singapore; Research and Evaluation Department*. Singapore: Ministry of Health; 2005:24—36.
4. Haslam DW, James WP. Obesity. *Lancet*. 2005;366:1197—1209.
5. Buchwald H, Williams SE. Bariatric surgery worldwide 2003. *Obes Surg*. 2004;14:1157—1164.
6. Jia H, El Lubetkin. Obesity-related quality-adjusted life years lost in the U.S. from 1993 to 2008. *Am J Prev Med*. 2010;39:220—227.
7. World Health Organization. *Obesity and Overweight*. Available from, http://www.who.int/hpr/NPH/docs/gs_obesity; 2003. Accessed 16.04.11.
8. Ti TK. Singapore experience in obesity surgery. *Obes Surg*. 2004;14:1103—1107.
9. Ganesh R, Leese T, Rao AD, et al. Laparoscopic adjustable gastric banding for severe obesity. *Singapore Med J*. 2006;47:661—669.
10. Shen R, Dugay G, Rajaram K, et al. Impact of patient follow-up on weight loss after bariatric surgery. *Obes Surg*. 2004;14:514—519.
11. Buchwald H, Oien DM. Metabolic/bariatric surgery worldwide: 2008. *Obes Surg*. 2009;19:1605—1611.
12. Lomanto D, Lee WJ, Goel R, et al. Bariatric surgery in Asia in the last 5 years (2005—2009). *Obes Surg*. 2012;22:502—506.
13. Moy J, Pomp A, Dakin G, et al. Laparoscopic sleeve gastrectomy for morbid obesity. *Am J Surg*. 2008;196:e56—e59.